Improvements in or relating to systems of raising liquids

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Inventor:
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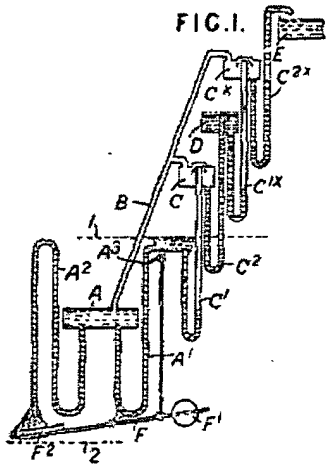
Abstract of **GB181762**

181,762. Allen, T. G. Jan. 25, 1921. Direct air-pressure apparatus, automatic; air- compressing devices, application of; raising by stages.-A system of raising liquid to a reservoir E by means of static pressure obtained from a canal &c., a portion 1 of which is at a higher level than the rest 2, comprises a tank A, which is alternately emptied and filled under the influ- ence of the static pressure resulting from the head of water due to the difference in water levels, and is connected by an air pipe B to a closed container C, arranged above the level of the liquid to be raised, and connected by a pipe C<1> to said liquid and by another pipe C<2> directly or indirectly to the reservoir E. In the form shown, the con- tainer C delivers to an open vessel D from which another closed container C<x> draws by a pipe C<1x> and then delivers to the reservoir by a pipe C<2x>. The chamber A discharges through a valved pipe or a siphon A<2> and thereby creates a vacuum in the pipe B and chambers C, C<x>. Liquid then enters the containers C, C<x> by the pipes C<1>, C<1x>. When the liquid ceases to flow from the siphon A<2> on to a plate F<2> carried by a lever F, a counterweight F<1> turns the lever and opens a valve. A<3> controlling the supply of liquid to the chamber A. As the chamber fills, the air in the pipe B is compressed and forces the liquid out of the containers C, C<x> into the tanks D, E. The bent pipes A<1>, A<2>, C<1>, C<2>, C<1x>, C<2> form water seals and may be replaced by pipes with non- return valves.

FIG.I.



PATENT SPECIFICATION

Application Date: Jan. 25, 1921. No. 3139/21. **181,762**

" " Apr. 20, 1921. No. 11,472/21.

One Complete Left: Aug. 9, 1921.

Complete Accepted: June 26, 1922.

PROVISIONAL SPECIFICATION.

No. 3139, A.D. 1921.

Improvements in or relating to Systems of Raising Liquids.

I, THOMAS GASKELL ALLEN, a citizen of the United States of America, of 106, Victoria Street, Westminster, in the County of London, do hereby declare the nature of this invention to be as follows:—

This invention relates to a system of raising liquids and has for its chief object to devise means whereby water can be raised efficiently without the use of a mechanical pump or hydraulic ram from a river or canal (a portion of which is either naturally situated or is artificially maintained at a higher level than the rest) to a reservoir which is arranged at any suitable height above the high level water and from which the water can be drawn, when required, for any desired purpose such as the supplying of a town with domestic water or the generation of electricity for power and lighting.

According to the invention I provide a tank or other closed chamber (hereinafter termed the operating chamber) which is alternately filled with water and emptied under the influence of static pressure resulting from the head of water due to the difference in water levels and which is connected by a pipe containing a column of air to a container arranged above the high level water and in communication by a closed channel with the liquid to be raised which liquid will be hereinafter described as being the high level water; the arrangement is such that when the operating chamber is being emptied (the inlet thereto being at this time closed) a suction is created which causes water to be drawn from the high level into the container and when the operating chamber is being filled (the outlet therefrom being at this time closed) a pressure is created which forces the water from the container either directly or indirectly into the reservoir, the container having suitable flap or other non-return valves which permit this cycle of operations to take place. With a single container the maximum quantity of water proportionate to the size of the operating chamber and the container, can be raised per cycle of operations to a relatively small height according to the effective head of water; but in order to raise a smaller quantity of water, during each cycle, to a greater height I provide a number of containers arranged at successively increasing heights above the high water level with an intermediate open vessel interposed between and connected by pipes to each pair of containers. The vertical distances between each pair of containers are preferably equal and the intermediate open vessels are preferably situated midway between the containers. Each of the containers is connected to the aforesaid pipe containing the column of air (which pipe is made strictly air-tight) and each of the intermediate open vessels is unconnected to the said pipe except through the containers, but is open to the atmosphere. The lowermost container is in communication with the high level water and the uppermost container communicates with an upwardly extending conduit leading the water from this container into the reservoir above the surface of the water therein. Assuming the aforesaid operating chamber and the intermediate open vessels to be filled with water, the inlet to the operating chamber is closed and the outlet opened, with the result that the water is drawn therefrom by reason of

[*Price* 1/-]

the head of water in the outlet pipe; the consequent suction created in the aforesaid air-tight pipe causes water to be drawn into the lowermost container from the high level water and the water in the successive intermediate open vessels to be drawn into the next highest containers. During this suction operation communication between each container and the intermediate open vessel next above it (and in the case of the uppermost container communication between it and the conduit leading to the reservoir) is automatically cut off by non-return valves whilst air from the atmosphere enters the said open vessels from which the water is being drawn. At the end of this operation the containers are therefore full of water and the intermediate open vessels are full of air. The outlet from the operating chamber is then closed and the inlet opened; the consequent entry of water into the operating chamber under the water head then exerts pressure through the column of air in the aforesaid air-tight pipe, upon the water in the various containers with the result that the water therein is forced into the next highest intermediate open vessels and, in the case of the uppermost container, into the reservoir. During this forcing operation communication between each container and the intermediate open vessel next beneath it is cut off by a non-return valve as is also communication between the lowermost container and the high level water, whilst the non-return valve between each of the containers and the next highest intermediate open vessel is open as is also the non-return valve between the uppermost container and the conduit leading to the reservoir. During succeeding emptyings and fillings of the operating chamber the above described operations are repeated and it will therefore be seen that a mass of water is thereby raised to the reservoir in a number of stages.

The volume of the aforesaid operating chamber should be at least equal to the total volume of the several containers and the volume of each intermediate open vessel should be at least equal to that of each container. The said operating chamber is preferably arranged midway between the surface of the high level water and the surface of the low level water so that the heads of water producing the forcing and suction operations are equal. The vertical distance between each container and the intermediate open vessel immediately above and below it is determined by the working head of water above and below the operating chamber, whatever it may happen to be. For instance, the clear distance between any container and the next intermediate open vessel above it should be not more than the net vertical height of the water column in the inlet pipe leading from the high level water to the top of the operating chamber, less the combined depths of the container and the intermediate open vessel to be filled. Likewise the clear vertical distance between any container and the next lower intermediate open vessel should not be greater than the net vertical height of water in the outlet pipe from the bottom of the operating chamber, less the combined depths of the intermediate open vessel and the container. The reason is that only the minimum working water head is available when the operating chamber is filled with water at the finish of the forcing operation just when it is called upon to sustain the maximum water head measuring from the bottom of the container to the top of the intermediate open vessel above. Likewise only the minimum working water column is available when the operating chamber is empty at the close of the suction operation just when it is called upon to hold the maximum water column measured from the top of the container to the bottom of the intermediate open vessel below. The valves or taps controlling the entry and exit of water to and from the operating chamber may be suitably interconnected and hand operated or they may be operated automatically in any suitable manner, for instance by clockwork or by a device responsive to the changing conditions in the operating chamber.

It is to be understood that although only one operating chamber has been referred to, any desired number arranged in parallel with the aforesaid air-tight pipe containing the column of air and communicating with a series of containers, may be employed. It is also to be understood that any desired arrangement of operating chamber or chambers other than that in which the said chamber or chambers are situated mid-way between the two water levels, may be adopted.

In order to avoid the use of the aforesaid non-return valves I arrange the inlets to all the containers and the intermediate open vessels above the high water levels in each and so arrange the inlet and outlet pipes of all the containers as to form water-seals or traps of a depth exceeding the head of water that effects the forcing and suction operations. With

this arrangement the forcing operation will depress, and the suction operation will elevate, the water in the water-seals to a column equal to the working water head, but when this position of equilibrium has been reached the water-seals will still be unbroken and will effectually prevent any air communication between each container and the next lower or next higher intermediate open vessel according as the forcing or suction operation is in progress. It is to be observed that in this arrangement the only moving parts in the whole system are the valves or taps controlling the entry and exit of water to and from the operating chamber or chambers.

Dated this 25th day of January, 1921.

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Park Row Building, 15, Park Row, New York, N.Y., U.S.A.,
Agents for the Applicant.

PROVISIONAL SPECIFICATION.

No. 11,472, A.D. 1921.

Improvements in or relating to Systems of Raising Liquids.

I, THOMAS GASKELL ALLEN, a citizen of the United States of America, of 106, Victoria Street, Westminster, in the County of London, do hereby declare the nature of this invention to be as follows:—

This invention relates to the system of raising liquids set forth in the Specification of my earlier Patent Application No. 3139 of 1921 and has for its chief object to devise means for obviating the necessity for employing the valves or taps that control the entry of water to and its exit from the operating chamber as described in my said specification.

According to the present invention the operating chamber as it becomes full of water is automatically emptied by means of a syphon pipe arrangement the flow of water from which operates upon a device serving to effect the closing of a sluice gate or the like controlling the supply of water to the chamber; when the water ceases to flow from the syphon pipe the said device operates to effect or permit the opening of the sluice gate to admit water to the said chamber through a pipe which is arranged so as to form a water-seal or trap.

The said device may comprise for example a perforated vessel into which the water from the syphon pipe flows and which is connected to the sluice gate so that when the vessel becomes full of water and is maintained full by the flow from the syphon pipe, the weight of the vessel and the water will close the gate and keep it closed. When the flow from the syphon pipe ceases the water empties from the vessel through the perforations therein. The lightened vessel will then rise and the gate open under the influence of a counter-weight or spring. Two of the aforesaid chambers with sluice gates and syphon outlets may be provided and arranged to work alternately; in this case the sluice gates may be interconnected by a pivoted beam so that the weight of the water in one of the vessels serves not only to close the sluice gate to which that vessel appertains, but also to open the other sluice gate.

In an alternative arrangement the above-mentioned perforated vessel may be replaced by an inclined platform adapted to rock about a pivot or fulcrum. This platform is suitably connected to the sluice gate and the syphon pipe discharges on to part of it in order to close the sluice gate and keep it closed until the water ceases to flow when the gate opens under the influence of a weight or spring. The edges of the part of the platform on which the syphon pipe discharges may be provided with upstanding flanges to prevent the water from flowing over the sides.

Dated this 20th day of April, 1921.

HASELTINE, LAKE & Co.,
28, Southampton Buildings, London, England, and
Park Row Building, 15, Park Row, New York, N.Y., U.S.A.,
Agents for the Applicant.

COMPLETE SPECIFICATION.

Improvements in or relating to Systems of Raising Liquids.

I, THOMAS GASKELL ALLEN, a subject of the King of Great Britain, formerly a citizen of the United States of America, of 106, Victoria Street, Westminster, in the County of London, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a system of raising liquids and has for its object to devise improved means whereby water can be raised efficiently without the use of a mechanical pump or hydraulic ram, by static pressure obtained from a river, canal or other body of water a portion of which is either naturally situated, or is artificially maintained, at a higher level than the rest, to a reservoir which is arranged at any suitable height and from which the water can be drawn when required, for any desired purpose such as irrigation, the supplying of a town with domestic water or the generation of electricity for power and lighting.

According to the invention I provide a tank or other closed chamber (hereinafter termed the operating chamber) which is situated between the high level water and the low level water with the required effective net head above and below it and is alternately filled with water and emptied under the influence of static pressure resulting from the said heads to exert pressure and suction alternately upon a column of air or other gaseous medium in a conduit connected to a closed container arranged above the level of the liquid to be raised, the said container having a downwardly extending conduit which communicates with the liquid to be raised and through which the said liquid is sucked into the container during the emptying of the operating chamber, the water inlet to the latter being at this time closed, and the said container also having an upwardly extending conduit through which the liquid is forced from the container during the filling of the said operating chamber, the water outlet from the latter being at this time closed. The liquid to be raised will hereinafter be described as the high level water but it may be any other liquid. With a single container the maximum quantity of water (proportionate to the size of the operating chamber and the container) can be raised at each cycle of operations to a relatively small height according to the effective head of water; but in order to raise a smaller quantity of water, during each cycle, to a greater height I provide a number of containers arranged at successively increasing heights above the high level water with an intermediate open vessel interposed between and connected by conduits to each pair of containers. The vertical distances existing between each pair of the containers are preferably equal and the intermediate open vessels are preferably situated midway between the containers.

In order that the said invention may be clearly understood and readily carried into effect the same will now be described more fully with reference to the accompanying drawings in which:—

Figure 1 is a view shewing diagrammatically a form of my invention, and

Figure 1ª is a view of a constructional form of the operating chamber and its associated parts.

Figure 2 is a view similar to Figure 1 shewing a slightly modified form of the invention.

Figure 3 is a diagrammatic view shewing a modified arrangement in which two operating chambers are used.

Referring first more particularly to Figure 1 the line 1 represents the surface of the high level water which is to be raised and the line 2 represents the surface of the low level water. A represents the aforesaid operating chamber which is situated at a suitable point betwen the surfaces of the high and low level water and which communicates by means of a U shaped pipe A^1 with the high level water and which is provided with a double U shaped outlet syphon pipe A^2, and B represents the aforesaid air pipe leading from the upper part of the chamber A. C, C^x represent two of the aforesaid containers connected to the air pipe B, D represents the aforesaid intermediate open vessel and E represents the aforesaid reservoir to which the high level water is to be raised. In the example shewn by Figure 1 the lower

container communicates with a trough G (supplied from the high level water) and with the intermediate vessel D by U-shaped pipes C^1, C^2 and the upper container communicates with the intermediate vessel D and the reservoir E by U shaped pipes C^{1x} and C^{2x}. The upper end of the pipes C^1, C^2, C^{1x} and C^{2x} communicate with the container C, the vessel D, the container C^x and the reservoir E respectively at points above the level occupied by the water therein during pumping operations and these pipes together with the pipes A^1 and A^2 are constructed to form water seals or traps of a depth exceeding the head of water that effects the forcing and suction operations so that the necessity for using non-return valves is avoided, although if desired such valves may be employed instead of the said seals or traps. In the arrangement shewn this head of water is the same for both forcing and suction owing to the fact that the vertical distance of the surface of the high level water 1 from the upper surface of the operating chamber A is the same as that of the outlet of the pipe A^2 from the lower surface of this chamber. In cases however where these distances are not equal, the water seals or traps must have a depth to suit the different water columns which effect the different forcing and suction operations; for example, the suction force being always limited to the pressure of the atmosphere which is approximately represented by a water column 33 ft. high, the suction operation will always be restricted to this height whereas the forcing operation is unlimited. In such a case the water seals or traps on the suction side of the containers must be made to resist the back pressure under the forcing operation, whilst those on the pressure or forcing side of the containers need only be long enough to resist the smaller suction force.

In the example shewn the pipe A^1 has a valve or cock A^3 suitably connected to a lever F one arm of which has a weight F^1 and the other arm has a platform F^2 on to which the water from the pipe A^2 flows and so rocks the lever F into the position shewn to close the valve A^3. When the water ceases to flow from the pipe A^2 the weight F^1 moves the lever F into a position to open the valve A^3. The emptying and filling of the chamber A thus takes place automatically. Instead of the said platform a perforated bucket may be used.

The most convenient way to prepare the system for automatic working is to fill with water all the closed containers and intermediate open vessels between the operating chamber and the reservoir, together with all the trapped connecting pipes. This can be done through the open pipes C^2 and C^{2x}, the air from the closed containers being thus forced out through the conduit B and the (as yet) unsealed outlet A^2 of the operating chamber. When the forcing operation is then allowed to take place the surplus water forced into the already filled open vessel D will overflow and run away. At the end of this first forcing operation the position will be as shewn in Figure 1 that is to say the intermediate vessel D is full of water, the water in the pipes C^1, C^2, C^{1x}, and C^{2x} is in the position shewn and the suction operation is just commencing. The head of water in the outlet portion of the pipe A^2 below the chamber A creates a suction in the air pipe B (the valve A^3 being at this time closed) and as the water flows out of the chamber A water is drawn into the container C from the high level water and into the container C^x from the intermediate vessel D. When the flow from the pipe A^2 has ceased, with the emptying of the chamber A, the weight F^1 moves the lever F to open the valve A^3 and water then enters the chamber through the pipe A^1 and pressure is thus exerted upon the water in the containers C and C^x through the air in the air pipe B. The water is thus forced from the container C into the intermediate vessel D and from the container C^x into the reservoir E. During succeeding emptyings and fillings of the operating chamber the above described operations are repeated and it will therefore be seen that a mass of water is thereby raised to the reservoir in a number of stages. The water in the U shaped pipes A^1, A^2, C^1, C^2, C^{1x} and C^{2x} forms water seals or traps during the forcing and suction operations.

In the arrangement illustrated by Figure 1[a] the operating chamber A and the water conduits A^1, A^2 are provided by two members built or formed to the shape shewn and connected together in any suitable manner. The air pipe B is connected to one of these members as shewn. In this case the valve A^3 would be replaced by a sluice gate as described with reference to Figure 2.

The arrangement shewn in Figure 2 is generally similar to that of Figure 1 except that the form of the water seals or traps is different, these being provided in Figure 2 by tubular chambers a^1, a^2, c^1, c^2, c^{1x} and c^{2x} in which the pipes A^1, A^2,

C^1, C^2, C^{1x} and C^{2x} are disposed with their lower ends near the bottom of these tubular chambers as is well understood. In this arrangement also the valve A^3 in the pipe A^1 is replaced by a sluice gate shewn diagrammatically at A^{3x}.

The volume of the aforesaid operating chamber should be preferably equal to the total volume of the several containers and the volume of each intermediate open vessel should be preferably equal to that of each container.

The said operating chamber as shown is so arranged that the heads of water producing the forcing and suction operations are equal, but where the suction force, in order to equal the pressure force would have to exceed the atmospheric pressure, the operating chamber is suitably arranged in a position nearer the low level water, so that the suction force is reduced and the pressure force correspondingly increased. The vertical distance between each container and the intermediate open vessel immediately above and below it is determined by the working head of water above and below the operating chamber, whatever it may happen to be. For instance, the clear distance between any container and the next intermediate open vessel above it should be not more than the net vertical height of the water column in the inlet pipe A^1 leading from the high level water to the top of the operating chamber, less the combined depths of the container and the intermediate open vessel to be filled. Likewise the clear vertical distance between any container and the lower intermediate open vessel should not be greater than the net vertical height of water in the outlet pipe A^2 from the bottom of the operating chamber, less the combined depths of the intermediate open vessel and the container into which the water is to be drawn. The reason is that only the minimum working water head is available when the operating chamber is filled with water at the finish of the forcing operation, just when it is called upon to sustain the maximum water head measuring from the bottom of the container to the top of the intermediate open vessel above. Likewise only the minimum working water column is available when the operating chamber is empty at the close of the suction operation, just when it is called upon to hold the maximum water column measured from the top of the container to the bottom of the intermediate open vessel below.

It is to be understood that although I have shewn and described the liquid that is raised to the reservoir E as being part of the water that provides the static pressure for operating the system, the said liquid may be quite independent of the said water and may also be at a different level from that of the high level water; for example the said liquid might be at the bottom of a well or pit and consequently below the level of the water that operates the system.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A system of raising liquids by means of static pressure obtained from a river, canal or other body of water a portion of which is either naturally situated, or is artificially maintained, at a higher level than the rest, characterised by the provision of a tank or other closed operating chamber which is situated between the high level water and the low level water with the required net head above and below it and is alternately filled with water and emptied under the influence of static pressure resulting from the said heads to exert pressure and suction alternately upon a column of air in a conduit connected to a closed container arranged above the level of the liquid to be raised, the said container having a downwardly extending conduit which communicates with the liquid to be raised and through which the said liquid is sucked into the container during the emptying of the operating chamber, the water inlet to the latter being at this time closed, and the said container also having an upwardly extending conduit through which the liquid is forced from the container during the filling of the said operating chamber, the water outlet from the latter being at this time closed, substantially as described.

2. A system of raising liquids as in Claim 1, wherein an indirect communication between the container and a reservoir takes place through one or more further closed containers communicating with the air conduit leading to the operating chamber and through one or more intermediate open vessels, substantially as described.

3. A system of raising liquids as in the last preceding claim, wherein the various conduits which convey the liquid to the reservoir are constructed to form liquid seals or traps, substantially as and for the purpose specified.

4. A system of raising liquids as in Claim 1, wherein the conduits by which

water enters and leaves the operating chamber are constructed to form water seals or traps, substantially as and for the purpose specified.

5. A system of raising liquids as in Claim 1, wherein the entry of water to the operating chamber is controlled by a valve or its equivalent which is automatically closed by the flow of water from the said chamber and is automatically opened when this flow ceases, substantially as described.

6. A system of raising liquids, carried out substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 9th day of August, 1921.

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28, Southampton Buildings, London, England, and
Park Row Building, 15, Park Row, New York, N.Y., U.S.A.,
Agents for the Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1922.

[This Drawing is a reproduction of the Original on a reduced scale]

Fig. 1.

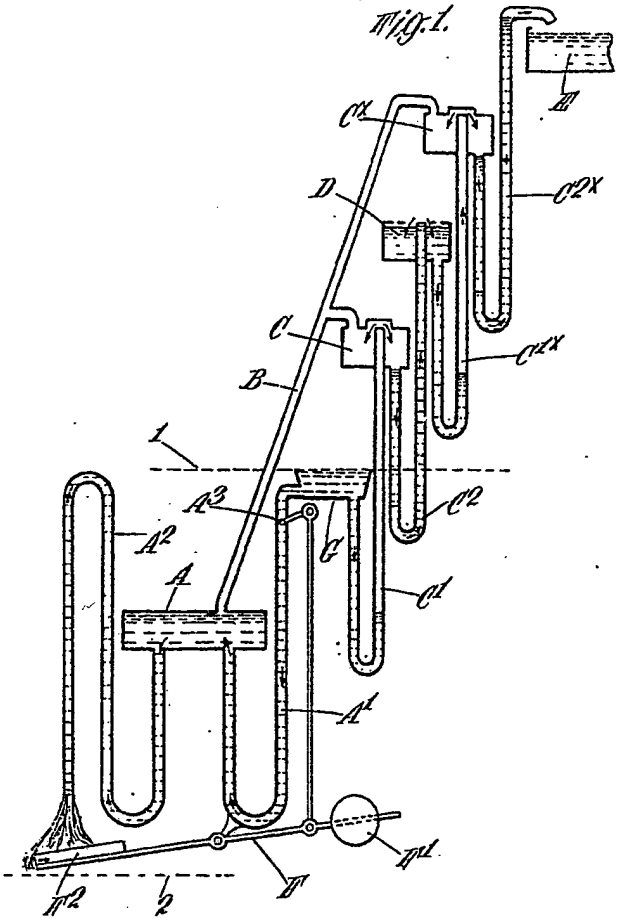
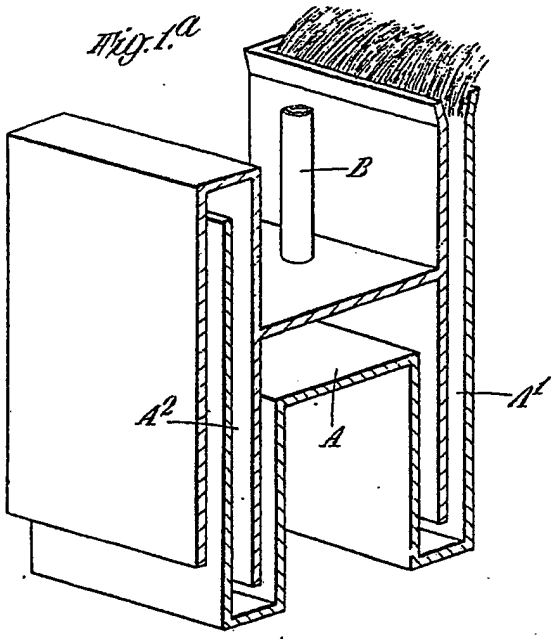


Fig. 1A.



SHEET 1

Fig. 2.

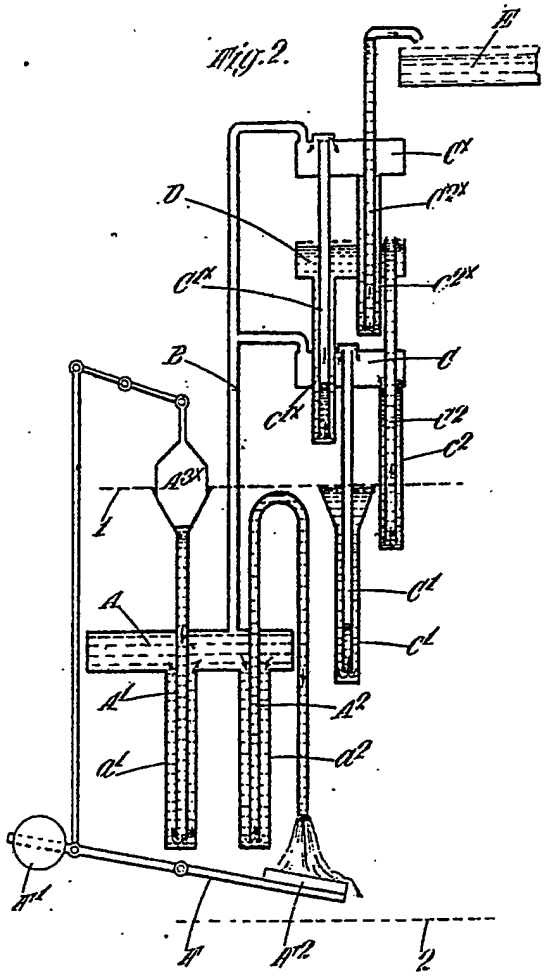


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Fig. 1.

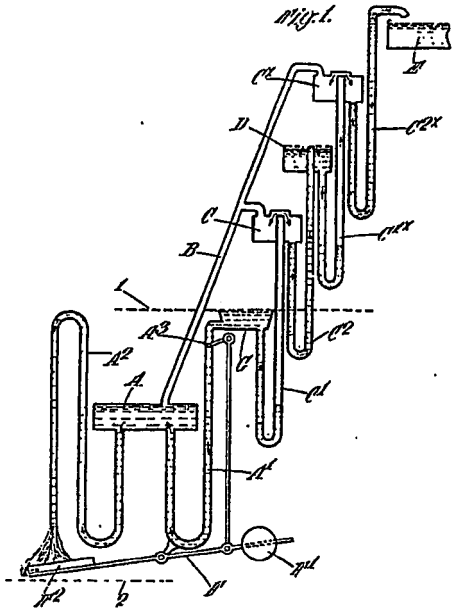


Fig. 1A.

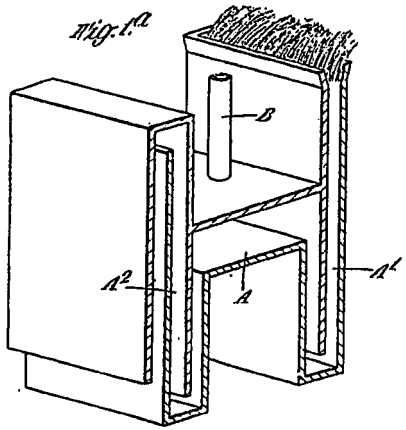
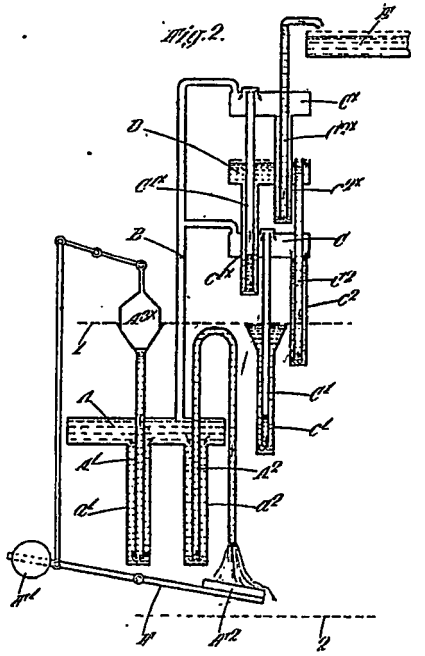


Fig. 2.



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